suggested. The most obvious suggestion is to the effect that it was derived from Hong Kong, which town had been the seat of a serious epidemic in 1894, and which in 1896 remained still infected. An alternative suggestion was put forward in the report of the German Plague Commission to the effect that it was derived from Garhwal. The suggestion was to some extent substantiated by the fact mentioned in the report in question that two thousand fakirs from Garhwal had arrived in Bombay on their way to a pilgrimage at Nassik shortly before the appearance of the disease. Plague is endemic in Garhwal (a district in the Himalaya Mountains), and this locality is therefore a possible source of infection. By conversation with a fakir who had attended the Nassik festival, Mr. Hankin learnt that the Garhwal fakirs only visit western India on occasions when the Nassik festival is being held. This festival is held regularly at twelve-yearly intervals.

It occurred to Mr. Hankin that if Garhwal was the source of the Bombay plague, by means of fakirs, it might also be the source of previous epidemics of plague in western India. On counting backwards from 1896 by twelve-yearly intervals, one arrives at 1836, the date of the Pali plague, and at 1812, the date of the Gujerat plague. That is to say, of the eight occasions on which these fakirs visited western India during the nineteenth century, on no less than three an outbreak of plague appeared. This fact may be regarded as strongly substantiating the suggestion of the German Plague Commission as to the origin of the Bombay outbreak. Further, it is stated by Forbes that the Pali plague originated in a village a few miles distant from the town of Pali shortly after the arrival of some wandering fakirs, and that it was preceded by a mortality among the rats. It was pointed out that these three plagues of western India had certain characters in common in which they differed from the majority of plagues in other parts of the world. First, they were characterised by their greater intensity and persistence; secondly, during the greater part of their course, at all events, they showed more virulence in villages than in towns; thirdly, they spread over the affected country, like a wave, from village to village, and showed but little tendency to travel along trade routes; fourthly, in each of the outbreaks the pneumonic form of the disease was frequently observed. The fact that these outbreaks resembled each other, and differed in general from outbreaks elsewhere, in the above characters, accords with the idea that they have a common origin. One apparent exception, however, which is of great importance must be described. This is the black death. So far as evidence goes, this outbreak was distinguished by each of the characters that have been ascribed to Indian plagues. In order, therefore, to be able to hold that Indian plague is of Garhwal origin, it is necessary to show that the black death may possibly have been derived from the same source.

The black death is known to have been imported into Europe from the town of Caffa, in the Crimea, where the Tartar army had been besieging some Italian merchants. According to an Arab historian, Aboel Mahasin, the plague was brought to the Tartar army from Tartary, where it was present in the year 1346, if not earlier. At that period, trade in horses and merchandise existed between India and Tartary. It is therefore necessary to investigate whether a Nassik festival occurred shortly before that time, and whether it was accompanied by an outbreak of pestilence. At first sight a study of Indian history appeared to negative the suggestion. It is stated, however, in Elphinstone's "History of India" that a rebellion broke out in Ma'bar in 1341, and that the army sent to suppress it was destroyed by plague. It appeared desirable to investigate this statement in detail. Counting back by twelve-yearly intervals, we arrive at 1344 as the year of a Nassik festival. In view of the great antiquity of Indian religious festivals, we are safe in assuming that in that year a number of fakirs emerged from Garhwal on their way to the sacred shrine. Ma'bar is situated on the Coromandel coast, on the Madras side of India, and one would expect that the army of the Emperor of Delhi would not march anywhere near to Nassik. But a contemporary history dealing with the conquest of Ma'bar, some thirty-five years previously, describes minutely the route then followed by the army. It appears to have lain through, or near, Nassik, and that the soldiers must have marched along the same route as the fakirs for all the first part of their journey. It is further recorded that when the army was destroyed by pestilence the Emperor himself was attacked, and that when suffering from the disease he halted at Deogiri, a town close to Nassik. It appears from a contemporary history that the army originally sent in 1341 was insufficient for its purpose, that the Emperor returned for reinforcements at a time when a famine was raging in Delhi, and that it was these reinforcements that were destroyed by the pestilence. The date of the famine is given as 1344. This is also given as the date at which the campaign terminated, and at which the rebels recovered their independence. Thus we have evidence that a plague broke out near Nassik in the year 1344, at a time when Garhwal fakirs were present, and it is obvious that this plague may have been carried to Tartary in time to have been the precursor of the black death, which is first known to have been present there in the year 1346. Other suggestions as to the origin of the black death, as, for instance, that it came from China, or from the supposed endemic area in Mesopotamia, or from the then existing endemic area of the Levant, if not contradicted by known facts, are at least unsupported by any positive evidence.

Prof. G. S. Woodhead asked whether it was known to what the pneumonic form of plague was due. Was it due to extra virulence or to the climatic conditions?

Sir Edward Candy asked if the outbreaks of plague in 1812 and 1836 spread and continued in the same manner as that of 1896, which re-appeared for some time after with every return of cold weather. It was noteworthy that the plague of 1896 took hold of the country up to the Punjaub, but missed out Calcutta and Madras.

In the course of his reply, Mr. Hankin pointed out that it was a remarkable fact that the pneumonic form of the disease showed but little tendency to spread as such by direct infection from person to person. Mr. Hankin had found that the plague virus lost its virulence by passages through rats. It was possible that it would also lose its virulence by passages through human beings, and that the true nidus of the disease in which it could retain or regain its virulence was to be found in some other living organism, as, for example, some species of flea. With regard to the important point raised by Sir Edward Candy as to the spread of plague, Mr. Hankin stated that it was a necessary corollary of his theory that the present outbreak of plague in India had not established itself in any other part of the world. It was probable that plague was carried from Hong Kong to Noumea, to Australia, to Madagascar, thence to South Africa, Oporto, and other localities. The present pandemic of plague was essentially a disease of sea-ports, in the first instance, and then of towns. It but rarely established itself in villages, and then always rapidly died out. In this and in other characters it showed itself distinctly different from the Indian form of the disease.

INVESTIGATIONS ON THE NUTRITION OF MAN.[1]

PROF. W. O. ATWATER, Middletown, Connecticut, chief of nutrition investigators of the United States Department of Agriculture, gave an account of the inquiry regarding the food and nutrition of man which is carried out in the United States by authority of Congress. The work is done by cooperation between the Department of Agriculture and a large number of universities, experiment stations, and other organisations from Maine to California. The headquarters is at Wesleyan University, Middletown, Connecticut, where the speaker, who is in charge of the work, is situated. The Federal Government devotes 20,000 dollars (4000*l*.) a year to the enterprise. This is used mainly as aid to research, and is supplemented by grants of money and other aid from State Governments and other sources. The inquiry has three aspects, one very practical, another more purely scientific, and a third educational.

On the practical side studies are made of the composition, the digestibility, and the nutritive values of food materials

[1] Abstract of an address before the Sections of Physiology and Economics at the Cambridge meeting of the British Association on August 23.

commonly used in the United States. This is done by chemical analyses and by actual experiments with men. Investigations are also made of the kinds, amounts, and costs of the food consumed by people of different classes and occupations in different parts of the country. The results throw valuable light upon the physiological, hygienic, and economic phases of the subject. At the same time experiments are made on various collateral topics, and thus information of the greatest usefulness is being acquired.

The more abstract scientific researches have to do with the transformations of matter and energy in the body, and consequently with the fundamental laws of nutrition. The experiments are made with men by use of the respiration calorimeter, an apparatus which serves to measure the changes which take place in the body with different diets and under different conditions, as, for instance, with physical or mental work or of rest. One very interesting result is the demonstration that the law of the conservation of energy obtains in the living body. Such purely scientific research is difficult and costly, but the speaker insisted earnestly upon its fundamental importance. These experiments show very clearly how the demands of the body for energy, for warmth, and work decide the needs for food. Taken in connection with the practical inquiries, they reveal much that was previously unknown regarding the uses of food and the adaptation of diet to health, purse, and welfare.

Numerous illustrations were given of the results of these inquiries. The average man on average diet digests and utilises about 96 per cent. of the material and 91 per cent. of the energy of his food, the rest being rejected in the excretory products; but the proportions thus utilised vary with the person, and still more with the food. The investigations bring out these differences in much detail.

The question of the nutritive values of bread made from ordinary white flour as compared with the whole wheat meal or brown flour, such as is used to make "brown bread," was considered. Chemical analysis shows that the bran which is removed in making the white flour contains considerable quantities of nitrogenous materials, and also of mineral matters, such as phosphates. A natural inference is that when the miller removes the bran he takes out the most valuable part of the flour. But the analysis in the chemical laboratory is not the same as that in the human body. The digestive apparatus of man has not the power to utilise the bran, consequently, when we eat the meal from the whole wheat we digest the part which makes the white flour and reject most of the ingredients of the bran. Cattle and sheep can digest the bran; the miller is therefore right in selling the bran for fodder for stock, and the white flour bread for man. This last statement perhaps requires a slight qualification. A large number of experiments with healthy men show that the nitrogenous ingredients of the bran escape digestion when made into bread, so that 1 lb. of white flour furnishes more digestible material than 1 lb. of the whole wheat meal; but it may be that the body obtains more phosphates from the whole wheat. This last question is still under investigation. The present probability, however, is that the chief value of the bran is as a stimulant to digestion in some cases where peristaltic action or the secretion of digestive juices is enfeebled.

While Prof. Atwater could hardly adopt the vegetarian theory of diet, he believed that the idea of the needs of large amounts of meat is often greatly exaggerated.

The investigations emphasise the great importance of a liberal diet for people engaged in muscular labour. They make it clear that in many cases the food of the poor is inadequate for normal nourishment, and must remain so until they have larger incomes or cheaper food.

The investigations also bring out clearly the reasons why people with sedentary occupations need less food than those with more physical exercise. Mental labour differs from muscular labour in requiring much less material and energy for its support. In general, people with sedentary occupations have the larger, and those whose labour is manual the smaller, incomes. Thus it comes about that the well-to-do are apt to be over-fed and the poor under-fed.

The application of these principles to some of the economic questions of the day was emphasised. High value was placed upon the inquiries of Mr. Rowntree regarding the conditions of living of the labouring classes in York. Other investigations in England and Scotland were referred to, and the statements of Mr. Charles Booth, in his monumental work on "Life and Labour in London," regarding the need of such an inquiry in Great Britain were quoted with approval.

"Half the struggle of life is a struggle for food"; half the wages of the bread-winner are spent on the food for himself and his family. Little regard is paid to the relation between the real nutritive value of food and its cost. The poor man's money is worst spent in the market, the poor man's food is worst cooked and served at home; here it is emphatically true that "To him that hath, shall be given, and from him that hath not, shall be taken away even that which he hath."

The importance of proper diet as an aid to temperance reform was emphasised. In countless cases in the United States, and he presumed the same was true in England, the home diet of the labouring classes is not what it should be, and the cooking and the serving of the food are the opposite of attractive. It is not strange that the people take to drink. One place to work against the evil of alcohol is at the table.

The educational aspect of the subject was also dwelt upon. The Federal and State Governments which support these inquiries, and the institutions and individuals who carry them on, lay great stress upon the distribution of the results among the people at large. Not only are the details printed in scientific memoirs, but the practical outcome is condensed in pamphlets and leaflets which the Government prints literally by the million, and distributes gratuitously. Copies of these publications were shown. Schools, from the lower grades to the universities, are introducing the subject into their curricula, and leading educators are coming to recognise that when such themes are treated in the true scientific spirit as revelations of natural law, and their significance and their connection with life and thought are explained, they are valuable both for mental discipline and for daily use. It is not a lowering, but a broadening, of the ideal of education which thus makes these subjects in the best sense humanistic.

In closing, Prof. Atwater urged the importance of such inquiries. He showed how they were already being actively pursued in the different countries of the world, in Europe, in Japan, and in the United States, and suggested that the time had come for the development of the science of the comparative nutrition of mankind.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following appointments are announced: Prof. Marshall Ward, F.R.S., to be a member of the general board of studies; Dr. W. E. Dixon to be assistant to the Downing professor of medicine; Mr. P. V. Bevan to be demonstrator, and Mr. C. Chittock to be assistant demonstrator, of experimental physics; Mr. J. J. Lister, F.R.S., to occupy the university table at the Plymouth Marine Biological Laboratory; Mr. J. W. Clark to be an additional manager of the Balfour Fund.

MR. H. M. MACDONALD, F.R.S., has been appointed professor of mathematics in the University of Aberdeen.

THE death is announced of Mr. Alonzo B. Cornell, who was the founder of Cornell University, and gave special attention to the development of teaching of scientific subjects at the university.

A COURSE of ten lectures on "The Chemistry of Proteids," by Dr. S. B. Schryver, was commenced on Wednesday, October 19, in the physiological theatre, University College, London, and will be continued on following Wednesdays at 5 p.m. The lectures are open to all internal students of the university, and also to medical men on presentation of their cards.

IT is reported, says *Science*, that about 60,000*l.* is left to public institutions by Mrs. Elizabeth Green Kelly, including 20,000*l.* to the University of Chicago. We learn from the same source that the will of Mrs. Sarah B. Potter, of Boston, contains public bequests aggregating more than